
BRIEF REPORT: COVID-19 EPIDEMIC TRENDS AND PROJECTIONS IN OREGON

Results as of 10-14-2020, 9pm

ACKNOWLEDGEMENTS

This is an update to the Oregon Health Authority's (OHA's) previous modeling reports. This report was based on Covasim modeling software, developed by the Institute for Disease Modeling (IDM). IDM provided OHA with initial programming scripts for the models and has provided support and technical assistance to OHA. OHA wishes to thank Cliff Kerr, Katherine Rosenfeld, Brittany Hagedorn, Dina Mistry, Daniel Klein, Assaf Oron, Prashanth Selvaraj, Jen Schripsema, and Roy Burstein at IDM for their support.

RESULTS UPDATED BIWEEKLY

Please note that the COVID-19 data used for the modeling are continually being updated. (For daily up-to-date information, visit the [OHA COVID-19 webpage](#).) The results in this brief are updated biweekly as more data become available, the science to inform the model assumptions expands, and modeling methods continue to be refined. The results are not intended to be predictive, but rather to be used for planning purposes. While these results can be used to understand the potential effects of different scenarios, point estimates should be interpreted with caution due to considerable uncertainty behind COVID-19 model assumptions, limitations to the methods, and recent changes in COVID-19 testing volume (which was temporarily reduced due to the wildfires).

KEY FINDINGS

Changes since Oregon began to reopen

- Based on COVID-19 data through October 8, the model is consistent with transmission increases throughout May, followed by transmission decreases from late-June through late-July.
- During August, the model suggests transmission decreased again, causing the estimated effective reproduction number (R_e) – the average number of secondary cases that a single case generates – to decrease below 1. Indeed, the number of new diagnosed cases and severe cases (those with symptoms severe enough to warrant hospitalization) had been declining during that time.
- In early September, transmission appears to have increased again, with the estimated R_e increasing to about 1.15 and remaining there. The data on severe cases and diagnosed cases are consistent with this trend.
- It is unclear from severe case data if transmission changed after September 26 because it takes an estimated 12 days, on average, from when a person becomes infected until they develop severe disease. In addition, hospitalization status is obtained through case investigation and is sometimes not known for weeks after the admission date. Trends in diagnosed cases can be an earlier indication of transmission changes, since the average time between infection and diagnosis is estimated to be 8 days, but the number of cases diagnosed is dependent on testing practices and reporting.

Future scenarios

We modeled three future scenarios with different assumptions about transmission starting October 9 and continuing over the next month.

- Transmission continues as-is: If we assume transmission continues at the current level over the next month, the COVID-19 outcomes will continue to increase. The model projects that by November 5:
 - The number of new daily infections (currently 1,300) will increase to 2,200.
 - The number of existing infections that are newly diagnosed each day (i.e., newly diagnosed cases) will increase to 570, assuming current testing practices continue.
 - The number of new severe cases each day will increase to 40.
 - There will be about 194,000 cumulative infections.
 - The R_e will remain at 1.15 (10th and 90th percentile estimates from 11 runs: 1.09 and 1.23).
- Transmission increases again: If we assume that transmission increases by 5 percentage points and continues at that level over the next month, the COVID-19 outcomes will increase more dramatically. The model projects that by November 5:
 - There will be approximately 1,200 more new daily infections (3,400 vs. 2,200), 170 more diagnosed cases each day (740 vs. 570), and 8 more new severe cases each day (48 vs. 40) compared to the continued as-is scenario.

- There will be about 211,000 cumulative infections.
 - The Re will be 1.30 (10th and 90th percentile estimates from 11 runs: 1.23 and 1.36).
- Transmission returns to August level: If we assume transmission decreases by 10 percentage points, thereby returning to the estimated August level, and continues at that level over the next month, the COVID-19 outcomes will start to decrease again. The model projects that by November 5:
 - There will be approximately 1,400 fewer new daily infections (800 vs. 2,200), 280 fewer new diagnosed cases each day (290 vs. 570), and 20 fewer new severe cases each day (20 vs. 40) compared to the continued as-is scenario.
 - There will be about 174,000 cumulative infections.
 - The Re will be 0.88 (10th and 90th percentile estimates from 11 runs: 0.82 and 0.95).

Each of these scenarios is based on different assumptions, as indicated above. The scenarios are meant to illustrate the effect of changing transmission on COVID-19 trends and should not be interpreted as a forecast range.

Conclusions

These results suggest that transmission increased substantially during May, then decreased in late-June through late-July causing the Re to decrease to less than 1. However, transmission appeared to increase again in early September, with the estimated Re increasing to above 1. If transmission remains at this level, the number of new infections will continue to increase. Given the virus is very sensitive to changes in transmission, Oregonians can reverse these trends; if they redouble prevention efforts and return to the August transmission level, cases will start declining.

The results in this report are not intended to be predictive, but rather to be used for planning purposes. Model point estimates should be interpreted with caution, given considerable uncertainty behind COVID-19 model assumptions, limitations to the methods, and recent changes in COVID-19 testing volume (which was temporarily reduced due to the wildfires).

PURPOSE OF THIS REPORT

This report describes trends in COVID-19 since Oregon began to re-open, and projects trends over the next month assuming different scenarios. This report complements the extensive epidemiologic data (e.g., demographic trends in cases, testing patterns) available at the [OHA COVID-19 webpage](#).

METHODS

This report presents analyses conducted using methods consistent with the October 1, 2020 report, with some key updates:

- Newer data from Oregon Pandemic Emergency Response Application (Opera) on COVID-19 cases ([Opera description](#)) were used. The Opera data file for this report was obtained on October 12, but data after October 8 were considered incomplete because of lags in reporting and were not used.
- In recent reports, we had observed an increased degree of inconsistency between “new” and “cumulative” outcome estimates in the scenarios. This issue remains for estimates of deaths, but currently appears minimal for estimates of infections, diagnoses, and severe cases (i.e., cases with symptoms severe enough to warrant hospitalization).

More information about the methods is in Appendix 1.

PUBLIC HEALTH INTERVENTIONS

Since the beginning of the pandemic, Oregon has implemented numerous public health measures to slow the transmission of COVID-19. Appendix 2 lists dates of specific interventions before and after reopening (reopening plans were announced on May 1, 2020). Together, these efforts comprise a comprehensive approach to protect the public’s health and well-being – with not only direct client services (e.g., testing and contact tracing), but also policy implementation (e.g., face covering requirements, limits on the size of gatherings), educational campaigns, culturally responsive approaches, support of community action, systems change to address barriers and inequities, and ongoing epidemiologic monitoring and evaluation. These interventions continue to evolve as the science expands, we learn about specific community needs, and more funding becomes available. As with other comprehensive public health interventions, it is difficult to determine the contribution of any one component because each is essential and they act synergistically; and, in the case of COVID-19, various components were implemented simultaneously or in quick succession.

MAJOR WILDFIRE EVENTS

Beginning in September, Oregon experienced numerous wildfires throughout the state. These wildfires were unprecedented in scope: an estimated 500,000 people were living in areas with differing levels of evacuation orders in place ([September 11 Press Release](#)). An estimated 40,000 people (1%) of the population were evacuated from their homes, and many people

moved to shelters. The potential effect these evacuations had on COVID-19 transmission is unclear ([OHA guidance](#)). Moreover, beginning September 8 virtually the entire state of Oregon experienced hazardous air conditions and residents were advised to stay indoors ([September 8 Press Release](#)). Since smoke is a respiratory irritant, it is not clear to what degree this exacerbated COVID-19 related symptoms ([CDC guidance](#)).

RESULTS

The results in this brief report will be updated as more data become available, the science to inform the model assumptions expands, and modeling methods continue to be refined (see Appendix 3 for information on the limitations). The models simulate the spread of COVID-19 in Oregon statewide under different scenarios. They do not model regional variability, and they do not take into account the complex disease spread or intervention effectiveness within and between specific populations over time, such as for communities of color, workers in certain occupations, or people in congregate settings. The models use average transmission levels; hence they do not, for example, model outbreaks in work settings differently than other types of transmission.

Epidemiologic trends to date

The model was calibrated (Figure 1) by modifying the assumptions from the literature to best fit data from Opera on cumulative counts of COVID-19 total diagnosed cases¹, tests completed, severe cases², and deaths for Oregon. The model was calibrated to observed data based on median daily values from 11 randomized runs. The early dates on which model transmission levels change were selected based on key policy enactment dates, but after March 23 they were based on data observation. The degree of changes in transmission were informed by the COVID-19 data, not by the assumed effect of any policy. It is important to note that the estimated reductions in transmission over time are imprecise and cannot easily be attributed to any particular action (e.g., policy or event), given some are based on few data points and sometimes multiple actions co-occurred.

As in previous modeling reports, the calibration provides evidence that Oregon's aggressive interventions -- combined with increased hygiene and other measures that appear to have begun earlier -- dramatically reduced the burden of COVID-19 in Oregon during the spring (Figure 1). Specifically:

- The data are consistent with a stepped reduction in transmission in Oregon, beginning with a 5% decrease in transmission after March 8, up to a maximum 80% decrease in transmission after March 23. Indeed, while the interventions before March 23 appeared to have slowed epidemic growth, the additional aggressive measures implemented on March 23 (i.e., "Stay Home, Save Lives") appeared to have further curtailed that growth. The reductions were likely due to people spending more time at home, as well as an

¹ Total diagnosed cases include confirmed cases (positive test) and presumptive cases (symptoms with epidemiologic link).

² Severe cases include both cases admitted to the hospital and individuals who died but were not hospitalized. Approximately 7% of severe cases are deaths that were not hospitalized or of unknown hospitalization status.

increase in hygiene practices, wearing of face coverings, and physical distancing outside the home; however, the data to determine the relative contribution of each change are lacking.

- The data suggest that these dramatic reductions in transmission waned somewhat in April, but the number of new daily infections was still declining until early-May.

The current calibration provides evidence that transmission increased substantially during May, then decreased somewhat in late-June and late-July (Figure 1). Specifically:

- New severe cases stopped declining in mid-May before beginning to increase starting early in June. The trends were consistent with transmission increases of 5 percentage points after April 1, April 19, and May 1, followed by a 10 percentage point increase after May 15 (the start of reopening). Transmission appeared to have then decreased by 5 percentage points after June 28 and by another 7 percentage points after July 26, bringing the estimated effective reproduction number (R_e) – the average number of secondary cases that a single case generates – to below 1.
- Throughout August, the R_e was estimated to remain below 1. Indeed, the number of new diagnosed cases and severe cases declined during that time.
- In early September, transmission appears to have increased again, with the estimated R_e increasing to about 1.15 and remaining there. The data on severe cases and diagnosed cases are consistent with this trend.
- It is unclear from hospitalization or death data if transmission changed after September 26 because it takes an estimated 12 days, on average, from when a person becomes infected until they develop severe disease. In addition, hospitalization status is obtained through case investigation and is sometimes not known for weeks after the admission date. Trends in diagnosed cases can be an earlier indication of transmission changes, since the average time between infection and diagnosis is estimated to be 8 days, but the number of cases diagnosed is dependent on testing practices and reporting.

The model calibration slightly underestimated the number of deaths during August and September, but as of October 8 closely tracks the total number of cumulative deaths (Figure 1).

Based on the model calibration, we estimate that as of October 8, a total of 145,000 cumulative infections have occurred in Oregon, but only about 38,000 have been diagnosed (i.e., diagnosed cases) according to available data.

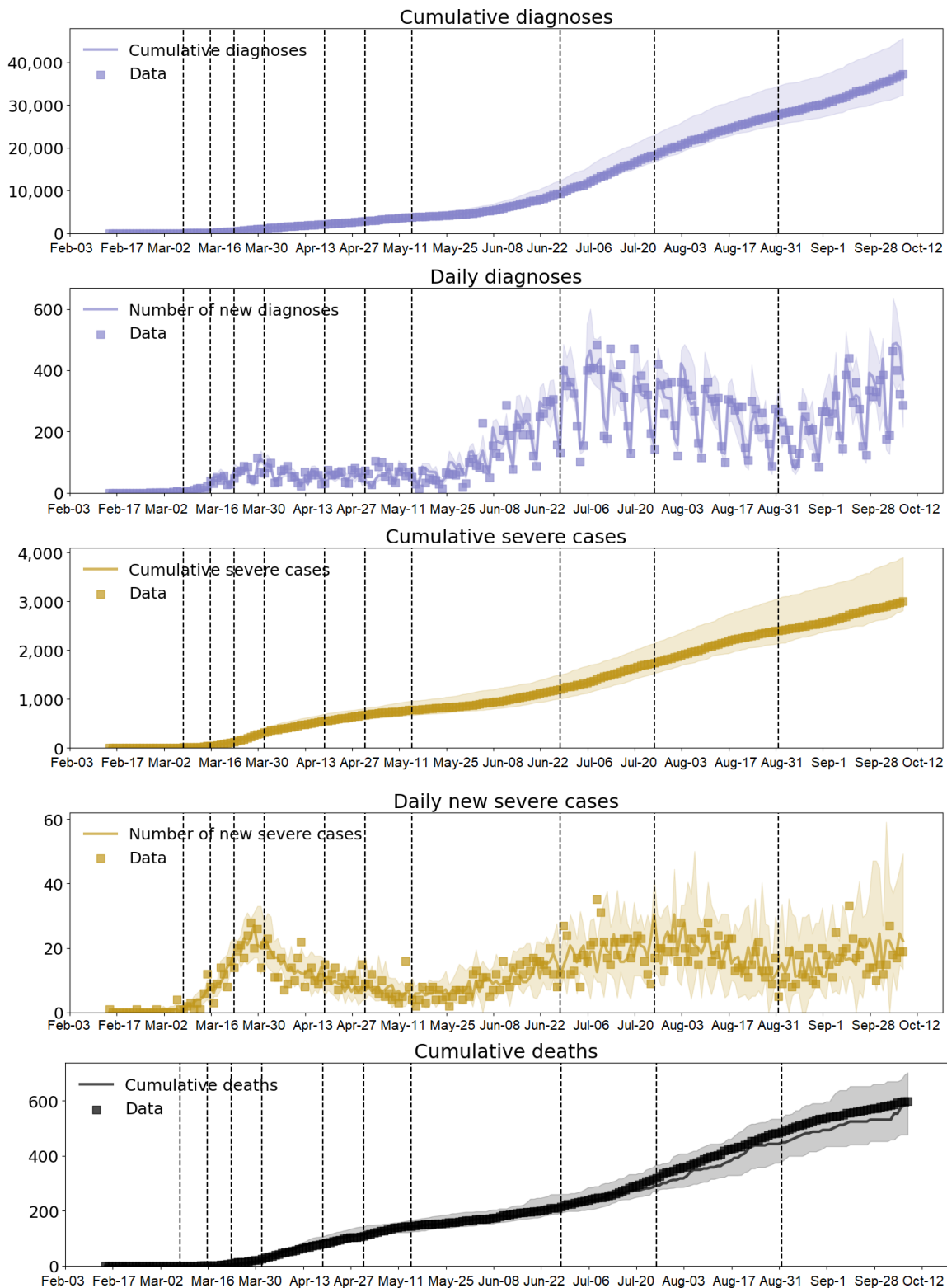


Figure 1: Model calibration with Oregon data. Dotted vertical lines correspond, from left to right, to estimated reductions in transmission relative to baseline of 5% (March 8), 45% (March 16), 80% (March 23), 75% (April 1), 70% (April 19), 65% (May 1), 55% (May 15), 60% (June 28), 67% (July 26), and 57% (September 1). Raw data are presented as squares; estimates from the calibration are presented as lines. The shaded areas represent variability among calibration runs (i.e., 10th and 90th percentiles of the calibration).

Scenario projections

We modeled three future scenarios through November 5 based on the calibration. Scenarios are meant to illustrate the effect of different transmission levels on COVID-19 trends and should not be interpreted as a forecast range. It is not possible to confidently predict future COVID-19 trends because of significant gaps in knowledge. For example, we do not have comprehensive measures of adherence to the physical distancing, face covering, hygiene, isolation, and quarantine guidance over time, and do not know what the effects of seasonal changes will be.

The estimates are based on results from 11 randomized runs. We present the median from those runs as a point estimate and present the 10th and 90th percentile estimates as an interval.³ For all scenarios, we assumed 4,500 tests per day, a conservative estimate, given the upcoming increase in access to antigen testing (described [here](#) and [here](#)). We will take this expanded testing into account in future reports, as we understand what proportion of these increased tests are positive.

- Transmission continues as-is: If we assume transmission continues at the current level over the next month, the COVID-19 outcomes will continue to increase. The model projects that by November 5:
 - The number of new daily infections (currently 1,300) will increase to 2,200.
 - The number of existing infections that are newly diagnosed each day⁴ (i.e., newly diagnosed cases) will increase to 570, assuming current testing practices continue.
 - The number of new severe cases each day will increase to 40.
 - There will be about 194,000 cumulative infections.
 - The Re will remain at 1.15 (10th and 90th percentile estimates from 11 runs: 1.09 and 1.23).
- Transmission increases again: If we assume that transmission increases by 5 percentage points and continues at that level over the next month, the COVID-19 outcomes will increase more dramatically. The model projects that by November 5:
 - There will be approximately 1,200 more new daily infections (3,400 vs. 2,200), 170 more diagnosed cases each day (740 vs. 570), and 8 more new severe cases each day (48 vs. 40) compared to the continued as-is scenario.
 - There will be about 211,000 cumulative infections.
 - The Re will be 1.30 (10th and 90th percentile estimates from 11 runs: 1.23 and 1.36).

³ “The forecast intervals used correspond to the 10th and 90th percentiles of the simulated trajectories. Although these forecast intervals bear some similarities to confidence or credible intervals, since they are typically produced through a combination of stochastic variability and parameter uncertainty, they do not have a rigorous statistical interpretation.” (p 18 of IDM Covasim report).

⁴ Based on recent diagnosis counts and the calibration estimate of recent new infections, results suggest Oregon is diagnosing approximately one-quarter of new infections.

- Transmission returns to August levels: If we assume transmission decreases by 10 percentage points, thereby returning to August levels, and continues at that level over the next month, the COVID-19 outcomes will start to decrease again. The model projects that by November 5:
 - There will be approximately 1,400 fewer new daily infections (800 vs. 2,200), 280 fewer new diagnosed cases each day (290 vs. 570), and 20 fewer new severe cases each day (20 vs. 40) compared to the continued as-is scenario.
 - There will be about 174,000 cumulative infections.
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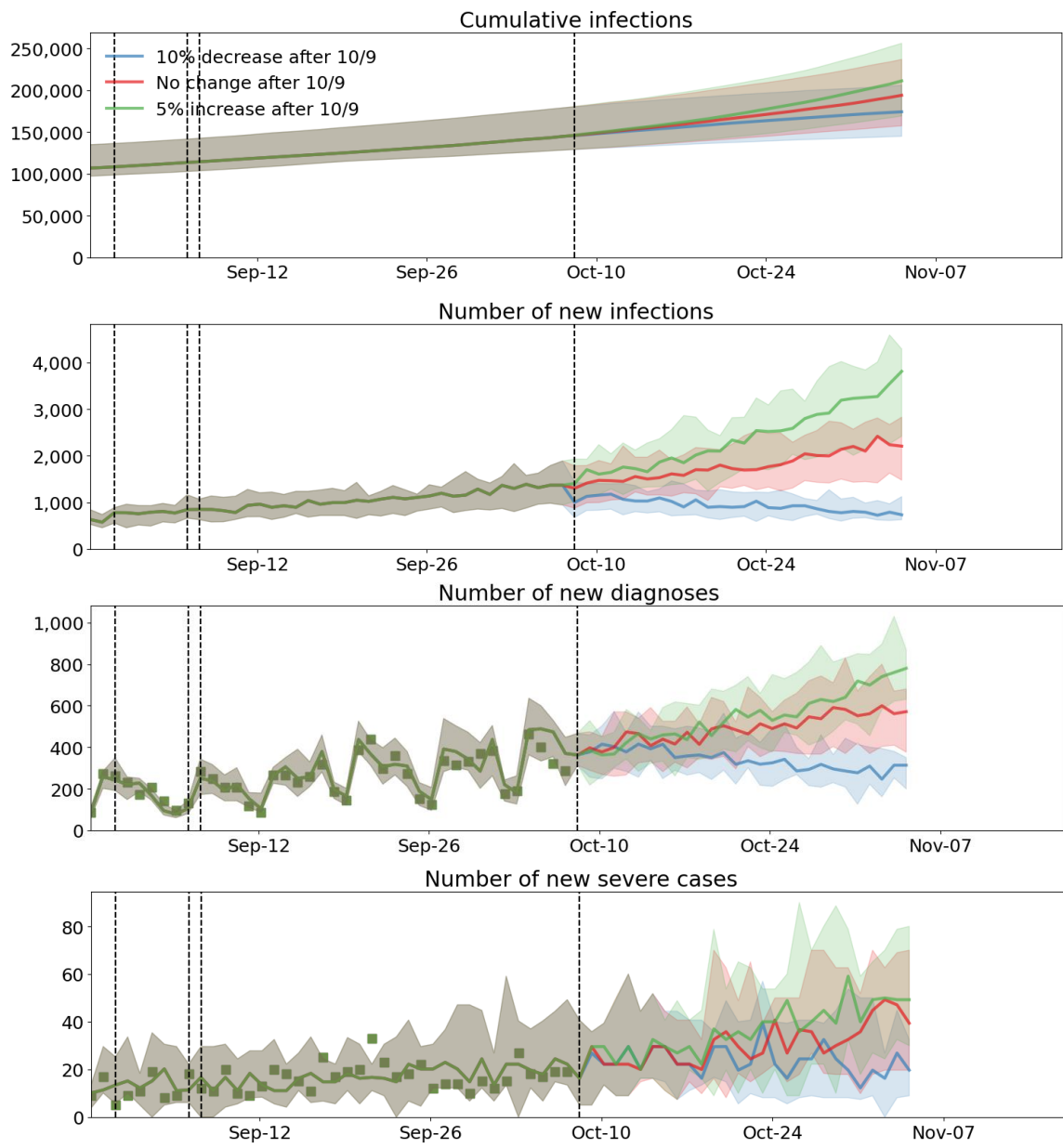


Figure 2: Model projections for the next 4 weeks, assuming that after October 8: 1) transmission decreases by 10 percentage points (blue line), 2) transmission does not change (red line), and 3) transmission increases by 5 percentage points (green line). The lines represent the median estimates

from the 11 randomized runs. The lighter shaded areas in the cumulative infections chart correspond to the 10th and 90th percentiles of the projection.

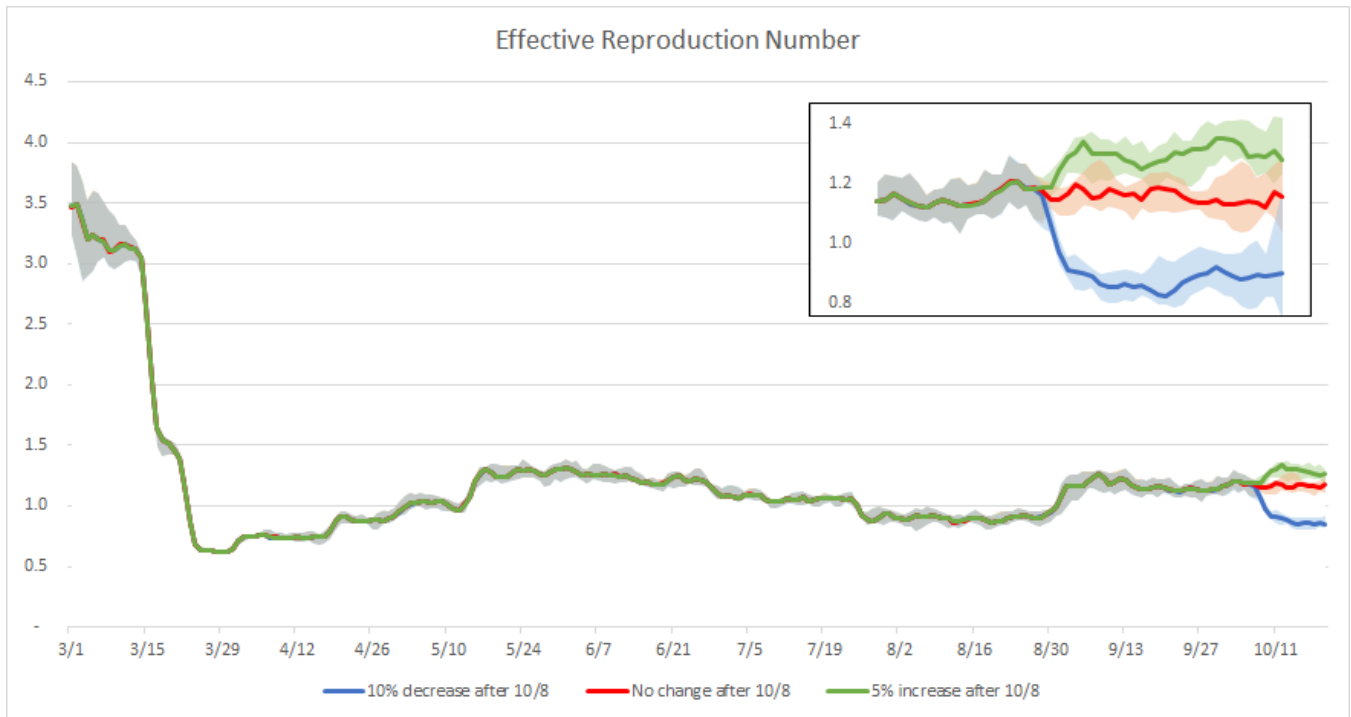


Figure 3: Projected effective reproduction number (Re) through November 5, assuming that after October 8: 1) transmission decreases by 10 percentage points (blue line), 2) transmission does not change (red line), and 3) transmission increases by 5 percentage points (green line). The lines represent the median estimates from the 11 randomized runs. The lighter shaded areas correspond to the 10th and 90th percentiles of the projection. Re is the average number of secondary cases that a single case generates; estimates vary day-to-day due to differences among randomized simulation outcomes.

Comparison with other model results⁵

[RT Live](#), [covid19-projections.com](#), [Covid Act Now](#), and [CMMID](#) estimate the Re (range or interval) for Oregon to be 1.02 (0.8 – 1.2), 1.03 (0.85 – 1.21), 1.08 (0.98 – 1.18), and 1.1 (0.9 – 1.3), respectively. Our calibration also estimated the Re to be greater than 1, but our point estimate was somewhat higher than these others: 1.15, with 10th and 90th percentiles of 1.09 and 1.23. As part of a sensitivity analysis, we fit another calibration assuming an 8 percentage point transmission increase on September 1 (instead of 10 percentage points). This calibration still fit the cumulative severe case curve fairly well but resulted in a slightly lower Re (1.09, with 10th and 90th percentiles 1.03 and 1.17). This analysis highlights the lack of precision in the model’s point estimates, but still suggests the Re is great than 1.

⁵ These websites for Re mentioned in this section were accessed on 10/14/2020. The CDC’s forecasts were accessed on 10/14/2020.

CDC compiles [hospital forecasts](#) from numerous modelers. Compared to CDC’s October 14 compilation, our “continues as-is” scenario predicts more daily hospitalizations and more of an increase over time than most other forecasts (Figure 4a).

CDC also compiles [forecasts of newly reported cases](#). Compared to CDC’s October 8 ensemble model, our “continues as-is” scenario predicts more weekly diagnosed cases and an upward trend (Figure 4b).

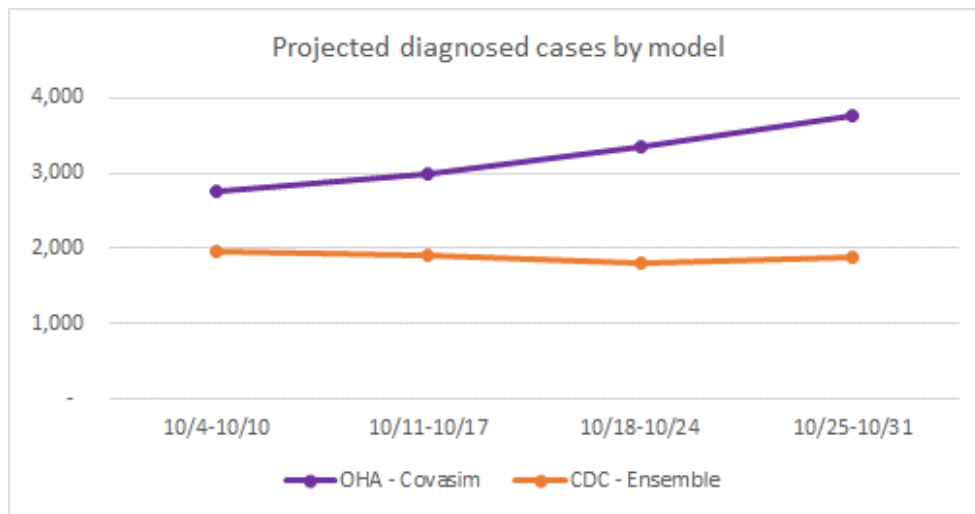
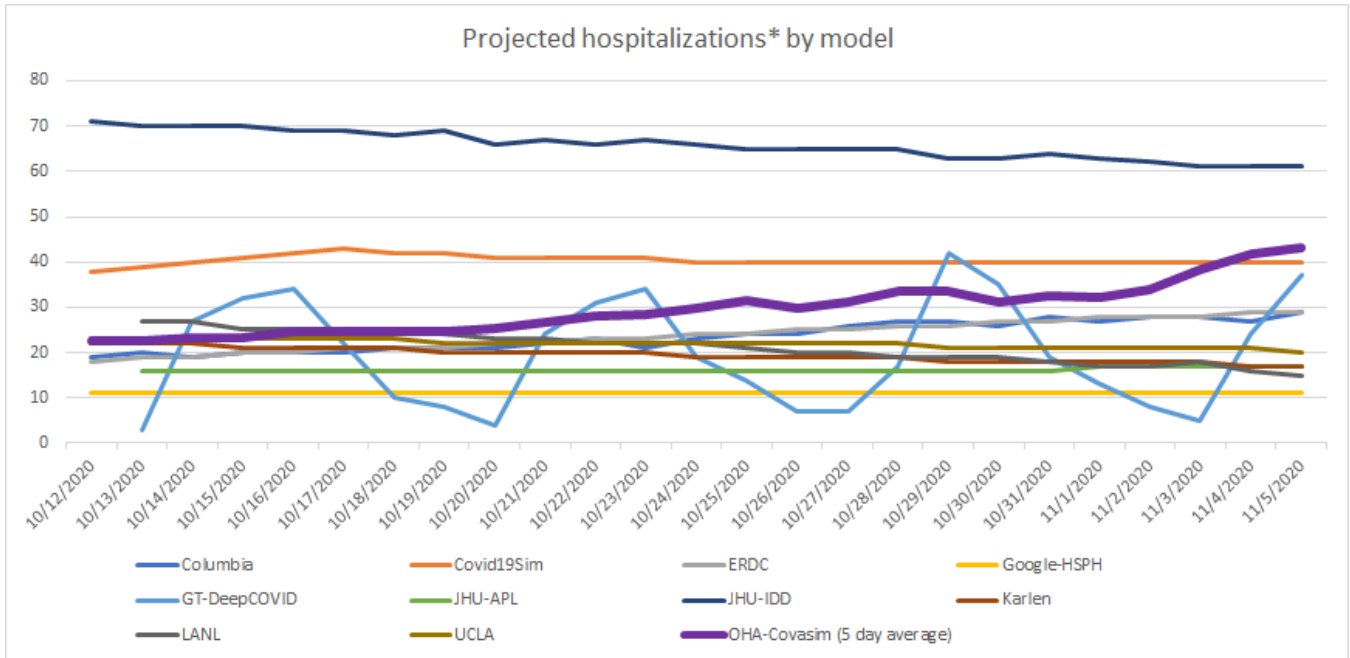


Figure 4a and b: Projected (a) daily new hospitalizations through November 5 and (b) weekly new diagnosed cases through the week ending October 31 in Oregon; estimates are from the current report’s “continues as-is” scenario (OHA Covasim) and other models included in CDC’s forecast compilations.⁶ *Note: OHA forecast in (a) is for severe cases, of which approximately 7% are deaths who were not hospitalized or of unknown hospitalization status.

⁶ CDC compilation for new hospitalizations was dated October 14 and for new diagnosed cases was dated October 8.

Recent trend in hospital occupancy

The Opera data file for this report was obtained on October 12, but data after October 8 were considered incomplete because of lags in reporting and were not used. Therefore, we lack data for the past week. [Trends in hospital occupancy](#) in Oregon from the HOSCAP data system, which is updated daily, show an increase in hospital-reported occupancy between October 8 and October 12.

Discussion

These results suggest that transmission increased substantially during May, then decreased in late-June and late-July causing the R_e to decrease to less than 1. However, transmission appeared to increase again in early September, with the estimated R_e increasing to above 1. If transmission remains at this level, the number of new infections will continue to increase. Other researchers also estimate Oregon's R_e is above 1. While the projected increases in infections is alarming, the virus is very sensitive to changes in transmission. Oregonians can reverse these trends; if they redouble prevention efforts and return to the August transmission level, cases will start to decline again.

This model projects statewide averages in case trends, but examining disparities is critical to inform interventions. For example, case trends vary by county ([Data dashboard](#)), and the Latinx and other communities of color have been disproportionately impacted ([OHA Weekly COVID Report](#)). In addition, even with testing, treatment, and contact tracing, transmission levels are still dependent on adherence to the guidance regarding physical distancing, face coverings, hygiene, self-quarantining of contacts, and self-isolation of cases. Collaborating with community partners to understand the structural, workplace, social network, and individual-level barriers to adherence to that guidance and addressing those barriers is essential to reducing transmission.

In addition, it is important to note that R_e is an average: the average number of secondary cases that a single case generates. However, other COVID-19 research (e.g., [here](#) and [here](#)) suggests that many people do not spread this virus to anyone; rather, this virus spreads in bursts and sometimes by people without symptoms. For example, outbreaks in Oregon have occurred in indoor social gatherings. These patterns highlight the need for everyone, including those without symptoms even when they are with friends and family, to adhere to public health guidance.

Model point estimates should be interpreted with caution, given considerable uncertainty behind COVID-19 model assumptions, limitations to the methods, and recent changes in COVID-19 testing volume (which was temporarily reduced due to the wildfires). In addition, we cannot confidently predict future COVID-19 trends because of significant gaps in knowledge. For example, we do not have comprehensive measures of adherence to the physical distancing, face covering, hygiene, isolation, and quarantine guidance over time, and do not know what the effects of seasonal changes will be. The results in this report are not intended to be predictive, but rather to be used for planning purposes.

APPENDICES

Appendix 1: Detailed transmission model methods

We applied Covasim version 1.7.2, an individual-based (i.e., “agent-based”) COVID transmission model with parameters informed by the literature; the full source code is available on [GitHub](#). The methods and assumptions for Covasim are described in detail [here](#). The model was calibrated by modifying the assumptions to best fit data from Opera on cumulative numbers of COVID-19 total cases, tests completed, and severe cases (hospitalizations and deaths) for Oregon.

Our model assumed random network connections, zero noise, and used default Covasim parameters, except for the following changes:

- 1) Population age distribution was based on American Community Survey 2018 single-year estimates for Oregon. We used a simulation population size of 420,000 with Covasim’s population rescaling functionality enabled.
- 2) The COVID-19 virus had a pre-intervention Beta value⁷ of 0.021, instead of 0.016 (based on observed severe cases before interventions took effect).⁸
- 3) We adjusted Covasim’s age-specific severe outcome probability parameters among all infections to be consistent with CDC’s suggested parameter values for pandemic planning scenarios ([CDC Planning Scenarios](#) as of May 20, 2020). Specifically, we used the CDC parameter values for age-specific hospitalization probabilities among symptomatic infections and adjusted them based on Covasim’s age-specific symptomatic probability parameters. After applying Oregon’s age distribution and time-varying age-specific susceptibility ratios (see point #4), our model estimates overall proportions of infections that become severe as 2.8% prior to May, and 2.0% for May-onward.
- 4) We adjusted Covasim’s age-specific probability of death parameters based on local ratios of deaths to severe cases by age.
- 5) Parameter assumptions were modified to vary susceptibility by age and time, such that the age distribution of severe cases in the model follows that of severe cases in Oregon over two time periods: February-April and May-July. The susceptibility odds ratios used in these respective time periods were: [2.84, 3.40] for age 0-9, [0.66, 1.19] for age 10-19, [1.17, 1.03] for age 20-29, [0.46, 0.52] for age 30-39, [0.50, 0.43] for age 40-49, [0.86, 0.66] for age 50-59, [0.77, 0.40] for age 60-69, [0.87, 0.54] for age 70-79, and [1.12, 0.88] for age 80 and higher. These ratios may partially correspond to biological susceptibility by age but are also a reflection of social behavior and testing activity. The populations of both diagnosed and severe cases have become younger over time in Oregon, implying a lower overall severe case risk among infections and thus more total infections per severe case in recent months.

⁷ Whenever a susceptible individual comes into contact with an infectious individual on a given day, transmission of the virus occurs according to probability Beta (β).

⁸ With Covasim defaults of 20 contacts per individual per day and front-loaded infectiousness over time, this transmission probability translates to a basic reproduction number (R0) of approximately 3.45.

- 6) To assess our parameter assumptions, we compared our model estimates of cumulative infections with what we might expect from a local seroprevalence study. That study ([MMWR article](#)) reported a crude seroprevalence of 1.0% (95% confidence interval: 0.2% – 1.8%) among a sample of people in Oregon interacting with the medical system between May 11 and June 15, 2020. Given the seroprevalence in that study varied by age and the sample was older than the general Oregon population, we calculated an age-adjusted seroprevalence for comparison and found it to be slightly lower (0.6%), but within the confidence bounds of the crude estimate. In the current report, the model estimated about 30,200 cumulative infections on May 15. This would translate to a seroprevalence of $30,200 / 4.2 \text{ million} = 0.7\%$, which is similar to the seroprevalence estimate from the MMWR article.
- 7) We determined transmission levels through mid-July based on severe case incidence and adjusted the assumptions about testing practices to reflect the observed test positivity rates. Specifically, the relative probability of symptomatic individuals being tested was adjusted to match actual diagnosed case counts given our inputted number of tests, with changes in relative odds occurring on April 7, July 13, and September 8.

It is not possible to calibrate the model with a single importation event near the first diagnosis (February 21, 2020), which was a community acquired infection. To match observed epidemic trend, we started the model with 75 infected individuals on February 15, 2020.

Appendix 2: Public Health Interventions in Oregon

Oregon has implemented numerous measures to slow the transmission of COVID-19. Since the beginning of the epidemic in Oregon, the state and local public health system has:

- Implemented educational campaigns to increase public awareness about the epidemic and to encourage adherence to guidance.
- Gathered and reported data, as part of public health surveillance, to inform interventions.
- Collaborated with the health care systems, local public health, and other sectors (e.g., education).
- Conducted outbreak investigations and implemented control measures to prevent future outbreaks in similar settings (e.g., congregate settings, workplaces).
- Collaborated with the federal government and health systems to expand access to key supplies (e.g., personal protective equipment (PPE), testing, and medications).
- Routinely investigated diagnosed cases, asked those cases to identify their close contacts, and then notified those contacts of their exposure (i.e., contact tracing). Because of limited public health resources in Oregon early in the epidemic, public health staff had only been able to actively follow up with contacts in households and congregate settings. Contact tracing efforts expanded starting with reopening plans, as mentioned below. Contacts have been asked to voluntarily stay in quarantine for 14 days after their last known exposure. Any diagnosed cases were originally asked to voluntarily isolate for at least 72 hours after symptoms resolve, but this changed over time: they are now asked to voluntarily isolate for at least 10 days after diagnosis or 24 hours after symptoms resolve, whichever is longer.

Specific dates for interventions are given below.

Before Reopening

- On March 8, 2020: Governor Brown declared an emergency due to the public health threat, as detailed [here](#).
- On March 12, 2020: A large number of measures were put in place, such as bans on gatherings of more than 250 people, as detailed [here](#).
- On March 16, 2020: Schools were closed statewide, as detailed [here](#). Further measures were put in place on March 16 and 17, including the closure of restaurants and bars for dine in, banning of gatherings of more than 25 people, recommendation to avoid gatherings of 10 people or more, and DHS restriction of visitors to long-term care and residential facilities, as detailed [here](#) and [here](#).
- On March 19, 2020: Non-urgent health care procedures were suspended to conserve personal protective equipment and hospital beds, as detailed [here](#).
- On March 23, 2020: Aggressive interventions, namely the [“Stay Home, Save Lives” recommendations](#), were put in place.

- On April 21, 2020: Testing guidelines were revised to allow for expanded testing, including testing of people who are asymptomatic and work in care settings or live in congregate settings; they were refined on [May 1](#), June 2 and again on [August 14, 2020](#) ([Revised testing guidelines](#)).

Reopening

On May 1, 2020, Oregon announced plans for phased relaxation of community mitigation strategies, with additional expansion of testing and contact tracing to keep transmission low ([Reopening Plans May 1, 2020](#)). Some key changes have included:

- On May 1, 2020: Certain elective and non-urgent medical procedures resumed ([Medical Procedures May 1, 2020](#)).
- On May 2, 2020: The widespread use of face coverings was encouraged, as detailed [here](#).
- On May 5, 2020: Some parks, outdoor recreation facilities, and areas across Oregon were opened for day use ([Parks May 5, 2020](#)).
- On May 7, 2020: Governor Brown published detailed guidance on reopening. This included requirements for counties to reopen, such as having sufficient capacity for testing and contact tracing. The guidance also called for the widespread public use of face coverings, maintaining physical distance of six feet between individuals as much as possible, and following good hygiene and disinfection practices ([Reopening Guidance May 7, 2020](#)).
- On May 15, 2020: Some counties began to reopen, and certain restrictions were eased statewide, such as allowing social gatherings of under 10 people and cultural/civic/faith gatherings of up to 25 people with physical distancing, as detailed [here](#) and [here](#).

Briefly:

- On May 15, 31 of the 36 counties in Oregon had been approved for Phase 1 of reopening.
- By June 1, 35 counties were approved for Phase 1 reopening. The most populous county (Multnomah) had not yet reopened.
- On June 5 and 6, 28 counties were approved for Phase 2 reopening, as well as one more on June 8.
- On June 11, due to a rise in COVID-19 cases, the Governor temporarily halted approvals for additional phased reopening.
- On June 17, the Governor approved Multnomah County's plan for Phase 1 reopening, starting on Friday, June 19.
- On June 23, 2020: An update on the expansion of contact tracing efforts was issued [here](#), reporting about 600 county and state contact tracers.
- On June 24, 2020: Implementation began of a new plan for testing at long-term care facilities, as described [here](#). October 6, DHS announced the initial baseline COVID-19 testing of staff and consenting residents in 683 long-term care facilities statewide has

been completed achieving the first of two objectives set by Governor Kate Brown's testing plan, as described [here](#).

- On June 25, 2020: The Governor required people living in Oregon's seven most populous counties to wear a face covering when in indoor public spaces, with some exceptions (e.g., young children, people with disabilities, while eating), as described [here](#). This requirement extended to all Oregon counties on July 1, as described [here](#).
- On July 15, 2020: Face coverings became required outdoors in situations where people are unable to maintain a distance of at least six feet from others, and most indoor gatherings of more than 10 people were not allowed, as described [here](#).
- On July 23, 2020: OHA announced grants to more than 170 community-based organizations (CBOs) to help respond to COVID-19 in culturally- and linguistically-responsive ways. Their work will include outreach and community engagement; contact tracing together with local public health authorities; and providing people with social services/wraparound supports, as described [here](#).
- On July 24, 2020: Face coverings were required for exercising indoors, and they became required for all children over 4 years old. Capacity limit for restaurants, gyms, venues was reduced to 100. Bars and restaurants were required to close at 10pm, as described [here](#).
- On July 28, 2020: The Governor released metrics to guide school district decisions about when it is safe to resume in-person instruction, and when a transition to comprehensive distance learning is necessary, as described [here](#).
- On July 31, 2020: Morrow County returned to Phase 1, and Umatilla County returned to Baseline/Stay Home because of increases in cases, as described [here](#).
- On August 1, 2020: Governor Brown announced the launch of a new source of financial assistance for agricultural workers who must self-quarantine to slow the spread of COVID-19, as described [here](#).
- On August 13, 2020: New face covering guidance required individuals to wear face coverings in any area within an office where six feet of distance cannot be consistently maintained, including in hallways, bathrooms, elevators, lobbies, break rooms and other common spaces, as described [here](#).
- On August 17, 2020: Malheur County returned to Phase 1 because of increases in cases, as described [here](#).
- On August 21, 2020: Umatilla County succeeded in reducing the spread of COVID-19 to the point that it was moved from Baseline Stay Home status to Phase 1, as described [here](#).
- On August 28, 2020: Oregon Department of Education's Early Learning Division released the new "Health and Safety Guidelines for Child Care and Early Education Operating in COVID-19." The updated guidelines take effect Tuesday, September 1, 2020, as described [here](#).
- On September 1, 2020: Governor Kate Brown extended the COVID-19 State of Emergency for 60 days, as described [here](#).

- On September 3, 2020: Governor Brown announced new requirements for entering Phase 2, as described [here](#). The original prerequisites for Phase 2 were based on trend-based metrics; however, the prerequisites now include that counties must have their case counts reduced to 100 cases or fewer per 100,000 population per week. Therefore, both Morrow and Umatilla Counties remained in Phase 1.
- On September 10, 2020: OHA, in response to the unprecedented wildfire evacuations, issued guidance for shelters for how to limit the spread of COVID-19 within their facility, as described [here](#).
- On September 11, 2020: OHA issued guidance for wildfire evacuation for people quarantining or isolating due to COVID-19, as described [here](#).
- On September 14, 2020: Oregon began receiving point-of-care antigen tests, with between 60,000 and 80,000 tests per week expected through the end of December. The new tests are being distributed statewide, as described [here](#) and [here](#). Briefly,
 - Tests are first being distributed to counties and long-term care facilities that have been affected by wildfire evacuations.
 - Tests are then being distributed for symptomatic people and their close contacts.
 - Testing is being prioritized for communities disproportionately impacted by COVID-19 and those living in congregate settings.
 - Tests will also be distributed to school-based health centers and other health care partners working with K-12 schools, as well as colleges and universities, to support the testing of symptomatic students and staff, testing of close contacts of cases, and outbreak investigations.
- October 6, 2020: OHA broadened its testing guidelines to identify additional cases among contacts and in preparation for large expansion of test availability, as described [here](#).

Appendix 3: Limitations

- The results in this report will be updated as more data become available, the science to inform the model assumptions expands, and modeling methods continue to be refined. The report uses the best available local data as of October 12, 2020; however, the local epidemiologic data on COVID-19 cases may lag in ways we did not account for. Data improvement efforts are ongoing.
- Our parameter assumption for the proportions of all infections (diagnosed or not) that become severe cases was based on CDC's hospitalization-among-symptomatic estimates and Covasim default symptomatic-among-infection estimates, then adjusted to observed local severe cases by age. However, there is considerable variability in this estimate in the literature. Underestimating this proportion would inflate our estimates of total number of infections (diagnosed or not), while overestimating would deflate the number.
- After the initial imported infections, the model assumes that no additional infections were imported from elsewhere over time. Any such infections would inflate local transmission levels, though any actual resulting diagnosed and severe cases in Oregon from imported infections are included in the data used for model calibration.
- For simplicity, we assumed random network connections and a combined effect of various interventions for the future scenarios (e.g., physical distancing, expanded testing and contact tracing) on overall transmission, but Covasim does have the ability to incorporate more complex network dynamics and specific intervention effects (as described [here](#)).
- We assumed that individuals who were diagnosed subsequently reduced their transmission by 80%, but this reduction may vary as social norms change.
- Our model assumed that diagnosed cases occur uniformly among individuals experiencing symptoms. On any given day, those with mild symptoms were assumed to be as likely to be diagnosed as those with more severe symptoms. We do not expect this to have a major effect on the model's estimate of transmission, however, because although severe cases are infectious longer, they are assumed to be less infectious over time.
- We have observed past instances of positive test results being reported sooner than negative results. When there is a recent discrepancy between predicted and actual diagnosed cases, we consider this a potential lead indicator of a change in transmission but interpret this with caution due to potential reporting bias. Our calibration is based primarily on severe cases.
- Although our model was calibrated to track actual numbers of tests and diagnosed cases, it assumed that diagnosed cases occurred largely among symptomatic individuals. It also did not explicitly account for reduced transmission from individuals who are not tested but undergo quarantine due to contact tracing efforts.
- Trends in cases and the age distribution (and therefore prognosis) can be sensitive to a single large outbreak or super spreader event. However, outbreaks and clusters appear to make up a smaller proportion of Oregon cases now than earlier in the epidemic, with

sporadic cases and household transmission becoming more common ([OHA Weekly COVID Report](#)).

- These models simulated the spread of COVID-19 in Oregon statewide under different scenarios. They did not take into account regional variability, nor the complex disease spread or intervention effectiveness within and between specific populations over time, such as for communities of color, workers in certain occupations, or people in congregate settings. However, the demographics of cases diagnosed over time in Oregon have been changing, as documented in the [OHA Weekly COVID Report](#).
- Our model includes COVID-19 deaths who were never hospitalized as severe cases. However, available data do not allow us to account for cases who reach severe medical status but recover without hospitalization.

Finally, significant unknowns remain, including information about public adherence to guidance (e.g., physical distancing, face coverings, hygiene, isolation, quarantine) over time, the disease dynamics, and treatment. As CDC stated ([CDC Planning Scenarios](#)) “new data on COVID-19 are available daily; information about its biological and epidemiological characteristics remain limited, and uncertainty remains around nearly all parameter values.”